



Epidural hematoma in computed tomography scan-based scoring systems of traumatic brain injury

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Dear Editor

Traumatic brain injury (TBI) is a harmful condition that permanently or temporarily damages brain functions and imposes enormous costs on health systems. Computed tomography (CT) scan is the preferred modality to detect injuries and determine TBI patients' prognoses in emergency departments. Thus far, some scoring systems have been introduced for grading TBI based on CT scan findings, including the Marshal,^[1] Rotterdam,^[2] Helsinki,^[3] Stockholm,^[4] and NeuroImaging Radiological Interpretation System (NIRIS) [Table 1].^[5] This letter aims to briefly raise issues regarding the scoring of epidural hematoma (EDH) in CT scan-based scoring systems of TBI.

Epidural hematoma is the gathering of blood between the dura mater and the skull. This intracranial hematoma usually occurs following the bleeding from the middle meningeal artery and, less commonly, from the dural venous sinuses.^[6] Some studies have shown that EDH positively affects the outcome, so patients with EDH would have a better overall prognosis.^[2] A typical EDH's prognosis is good if diagnosed early and managed before deterioration. Gennarelli et al., showed that the EDH death rate is approximately one-tenth of subdural hematoma.^[7] Bricolo et al., reported that mortality should be zero in uncomplicated EDH.^[8]

On the other hand, EDH can be potentially life-threatening. EDH of venous origin can gradually spread, and its findings may appear late, leading to a delayed diagnosis and treatment. Consequently, EDH expansion

can lead to herniation, permanent neurological damage, and death.^[9] EDH with a size greater than 30 ml or a midline shift of more than 10 mm does not have a good prognosis.^[9] The swirl sign indicating active bleeding also worsens the prognosis.^[10]

The presence or absence of EDH is evaluated in four CT scan-based scoring systems of TBI [Table 1]. Three scoring systems, including Rotterdam, Helsinki, and Stockholm, consider the presence of EDH as a favorable prognostic factor, i.e., patients with EDH on their brain CT scans get a lower score. However, in the NIRIS, EDH is scored as an adverse prognostic factor based on its volume, leading to a higher score.

Hence, EDH cannot always be a favorable prognostic indicator. For instance, the presence of EDH along with diffuse axonal injury (DAI) worsens the outcome.^[11] However, according to Rotterdam, Helsinki, and Stockholm systems, the association of EDH with DAI would have a lower score than DAI alone. Besides, high-volume EDH can worsen the situation by causing a midline shift and brain herniation.^[9] Nonetheless, the specific size of EDH is not checked in any of these three systems.

The scoring systems have been developed from the statistical weighting of variables. However, it is necessary to look at the issue more dynamically and comprehensively for a more accurate outcome prediction. Adjusting CT scoring systems with clinical characteristics and scales such as the Glasgow Coma Scale (GCS) and head injury biomechanics may also be helpful.

Table 1. Variables evaluated in five CT scan-based scoring systems of TBI

Variable ▶	Haemorrhage							Mass Effect				Other	
	EDH	SDH	SAH	IVH	IPH/ ICH	DAI	Duret	Mass Lesion > Size	Abnormal Cisterns	Midline Shift	Herniation		Hydrocephalus
Scoring System ▼													
Marshall ^[1]								X	X	X		***	
Rotterdam ^[2]	X*		X	X					X	X			
Helsinki ^[3]	X*	X		X	X			X	X				
Stockholm ^[4]	X*	X**	X	X		X				X			
NIRIS ^[5]	X	X	X	X	X	X	X	X		X	X	X	****

* As positive prognostic factor, ** Only dual-sided SDHs, *** Surgical evacuation of the lesion, **** Skull Fracture, Pneumocephalus, Parenchymal Contusion
 CT: computed tomography; DAI: diffuse axonal injury; EDH: epidural hematoma; ICH: intracerebral hematoma; IPH: intraparenchymal hemorrhage; IVH: intraventricular haemorrhage; NIRIS: NeuroImaging Radiological Interpretation System; SAH: subarachnoid hemorrhage; SDH: subdural hematoma; TBI: Traumatic Brain Injuries

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Competing interests

None.

Abbreviations

Epidural Hematoma: EDH; Computed Tomography Scan: CT-Scan; Traumatic Brain Injury: TBI; NeuroImaging Radiological Interpretation System: NIRIS; Diffuse axonal injury: DAI; Glasgow Coma Scale: GCS.

Authors' contributions

The authors read and approved the final manuscript. They takes responsibility for the integrity of the data and the accuracy of the data analysis.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Sina Hospital, Tehran University of Medical Sciences (IR.TUMS.SINAHOSPITAL.REC.1399.103) and supported by Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences, Tehran, Iran (grant number: 99-3-93-51199).

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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